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THE NAMING OF ROCKS

Introduction of new names.—In the early days of petrography it was supposed that there existed rock types as definite as mineral types. Following this hypothesis, a rock found which was different from any rock before described was immediately given a new name. This went so far that an altered rock was given a family name, as in the case of *diabase*, an altered dolerite. After some years a scheme of nomenclature was worked out which was supposed to be approximately complete. For a time subsequently, when a rock was discovered having a somewhat different character from previously known rocks, it was referred with modifying mineralogical prefixes to some of the so-called types.

A few years ago another period of name-giving was inaugurated. During this period, which continues to the present time, petrographers have introduced numerous new, independent names, both for long-known and for newly-discovered varieties of rocks. Since 1890 more than fifty new names have been added to the nomenclature of the igneous rocks, a larger number than young petrographers were obliged to know the meaning of before 1890. The stage through which petrography is passing is somewhat similar to that through which at one time paleontology passed. One might almost think that petrographers were seeking to find varieties of rock slightly different from those before known in order to give them new names.

Method in giving new names.—The method of petrographers in proposing names, so far as any method is discoverable, is to give an independent name to each rock which is slightly different from any previous rock found, without reference to any definite plan of nomenclature. The greater number of the names are not proposed to designate varieties which are subordinate to previously recognized kinds of rocks, but are names coördinate with those before used. In petrography, a binomial nomenclature thus far has not been generally adopted, and therefore it has not been possible to drop the new name and place the thing referred to under a larger division, as one may drop the specific name of a new fossil and speak only of the genus to which it belongs. Furthermore, the new names of petrography are in most cases unlike most of those in biology or in mineralogy, in that the things described and given names have no clearly distinguishable characteristics by which they may be recognized. As a result of this inherent vagueness, it is very difficult indeed, from the descriptions published, to obtain a clear conception of what is meant by many of the new petrographical names. Indeed, it may be doubted whether many professional petrographers, to say nothing of those who work in other lines of geology, have a definite conception of the meaning of many of the fifty or more names which have been proposed since 1890.

Principle underlying naming of rocks.—In giving numerous new names to rocks, while no principle is announced by the petrographers, the underlying assumption is the same as that which prevailed in the early days of petrography; that is, rocks may be divided into definite types, which are comparable to definite mineral or animal species. I do not for a moment suppose that petrographers who have introduced these new names would state that they believe this principle. I merely assert that many of the numerous names are justified only if the principle be true.

Responsibility of introducing new names.—The petrographer who introduces a new name for a rock assumes a responsibility which ought to be incurred only after the most careful consideration. Probably some of the new names which have been recently introduced were necessary to the progress of the science. That many of them were not, I venture to believe. One who introduces a new name without the best of reasons for so doing is hindering the advance of the science of petrography, as well as occasioning loss of time and great inconvenience to his fellow workers.

Statement of the problem.—All philosophical petrographers now understand that between all kinds of rocks there are gradations—from basic to acid, from coarsely granitic to glassy, from rich sodium rocks to rich potassium rocks, from massive lavas to tuffaceous forms, from the freshest rocks to the most altered, from the oldest rocks to the newest, from the igneous to the aqueous rocks; between all of the various forms of the sedimentary rocks. Moreover, many of the important stages of these gradations have been noted. Still further, in one region the gradation from one kind of rock is in one direction, and in another region is in a different direction. For instance, here a granite grades into a diorite; there grades into a syenite.

What shall be the criteria for naming rocks?—These being the facts, the question arises, what is the most important consideration which shall determine whether or not a certain kind of rock shall be assigned a name. It appears to me clear that the most important consideration is *the relative abundance of the rocks*. We must have names for the common things. It is well known that certain of the multifarious kinds of rocks which have been named are more abundant than others. Probably the igneous rocks, which can be included under twenty names, comprise nine tenths or more of the mass of the igneous rocks. It follows that a philosophical method of rock nomenclature involves a knowledge of the relative abundance of the different kinds of rocks.

However, it is not meant to imply that abundance shall be the only consideration in the naming of rocks, but merely that it shall be a fundamental one. While abundance ought to be the first consideration, this idea must not be pushed to an extreme. All rocks which must be assigned names will not be found in equal abundance. Some rocks which do not have specific names assigned to them may be more abundant than some other rocks deserving of a name. For instance, olivine-gabbro may be more abundant than some of the leucite rocks to which names must be assigned. This but illustrates the well-known principle that great variations due to secondary factors shall have weight in proportion to their range, and that therefore they may have an important modifying influence upon the application of the primary considerations.

Influence of rock classification on naming of rocks.—The broad question of rock classification I do not intend here to discuss. However, it is necessary to mention some of the criteria which are recognized in the classification of rocks, since these are also factors in the naming of rocks. By most petrographers, chemical composition, mineral constituents, and rock textures and structures are controlling considerations; but by different petrographers these are placed in different orders of importance. By some petrographers the distinction between plutonic and volcanic rocks is given weight in classification. In making a classification of rocks it is necessary to consider to what extent the altered rocks shall be recognized, and whether such textural terms as porphyry and obsidian shall be used in naming rock species. Doubtless different petrographers would decide these points in various ways.

Now the above factors, which are controlling considerations in the classification of rocks, are of necessity secondary factors in the naming of rocks. If a new rock be found, which, in regard to these secondary factors, is so different from any previously known rocks that it cannot be grouped with any of them by the plan given below, it may be entitled to a new family name, even if not abundant.

But to return to the matter of abundance. After a system of classification shall have been worked out by a petrographer, he must decide what rocks shall have independent names. It is my contention that at this point abundance shall be recognized as having the place of first importance. Names are tools by which we avoid the circumlocutions of descriptions. Since, as already shown, there are everywhere gradations between rocks, not every phase of rock can have an independent name, else the number of names would be infinite. Since every rock phase cannot be assigned a name, what kinds shall be selected for such names? Manifestly those which occur most abundantly. For the common things, the common kinds of rocks, as a matter of convenience, I repeat, we must have names.

As above noted, it has been supposed that a rock might be designated as a type which has certain characteristics. However, the only method of nomenclature which is logical is that which takes into account the fact of gradation and stages between all rock varieties; that types exist only as descriptions or specimens selected by man, not by nature; but abundance is determined by nature. All this is recognized in the scheme given. The definite forms which are selected for names are those which are abundant. This applies as well to the original forms of rocks as to their altered varieties. Had the varieties of rocks intermediate between those abundant kinds which have been given names been the abundant ones, rather than those to which names have been assigned, these would have been the rocks which should have been given names, and which in all probability *would have been given names* during the first period of the development of the science of petrography.

How shall demands for exactness be met?—But the question now arises as to how the demands of the petrographers for exactness shall be met without introducing a new independent name the moment a slightly different variety of rock is discovered, however small its mass. This demand may be met by the general application of special usages below given. The majority of the abundant kinds of rocks were early assigned names. To less abundant kinds of rocks intermediate between the more abundant kinds, names compounded from the simple names may be used; for example, granodiorite, trachydolerite, trachyandesite.[1] To either the simple or the compound names may be prefixed mineralogical qualifiers, thus further compounding them; for example, quartz-diorite, olivine-gabbro, analcite-basalt, augite-trachydolerite. With these simple or compound names, geographical qualifiers may be used. If the rock is so abundant and definite as to require a specific name, the geographical qualifier may be compounded with the more general name, as Hellefors-diabase. If, however, the idea is exactly to designate the rock occurring at a particular locality, without implying that it is so abundant and important as to require a name to enter rock nomenclature, the geographical name may be used simply as a qualifier, as, Duluth olivine-gabbro. This usage gives the most exact discrimination without cumbering nomenclature with a multitude of independent names. In any of the foregoing classes of names the prefixes meta, apo, epi, schisto, gneisso, or other terms may be inserted for the altered rocks.[1]

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[1] Italian petrographical sketches, V, by H S. WASHINGTON: JOUR. GEOL., Vol. V, 1897, pp. 365, 366.

Under the plan proposed we shall have coördinate simple names of about the value which Rosenbusch has designated as family for rocks which are the most abundant and important. We shall have compound names for rocks intermediate between the more abundant kinds. We shall have names with geological qualifiers, either compounded or not, as the case demands, for a further refinement in discrimination. In any of these three classes of names mineralogical qualifiers may be introduced as an additional discrimination. For all of the previous classes we shall have prefixes, with definite meanings, for the altered equivalents of the different rocks.

The method proposed is practically that of a binomial or trinomial nomenclature. The fundamental names would be based primarily upon abundance, and secondarily upon other factors. The secondary names would be introduced under the same principles.

Application of plan proposed.— How this plan can be worked out may be illustrated by some cases from recently described rocks. (1) *Nordmarkite*,[2] by Washington, is placed as equivalent to *mica-hornblende-quartz-syenite*. The rock is therefore a syenite. Assuming that this rock is sufficiently abundant so that it should have a place in nomenclature, it may be called *nordmarko-syenite*. In the same way, *akerite*[3] (augitic quartz-syenite) may be called

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[1] In another place (Metamorphism, Monograph, U. S. Geol. Surv.) I shall discuss in detail the use of these terms. But in the present paper I do not wish to take up the subject. Here I wish merely to suggest a method of handling the altered rocks, rather than to discuss the details of its application.

[2] The petrographic province of Essex county, by H. S. WASHINGTON : JOUR. GEOL., Vol. VI, 1898, p. 799.

[3] JOUR. GEOL., Vol. VI, p. 796.

akero-syenite, if a new name is really necessary and preferable to augitic quartz-syenite. (2) The trachydolerites, designated by Washington as *ciminite*, *vulsinite*, and *toscanite*,[1] may be called *cimino-trachydolerite*, *vulsino-trachydolerite*, and *toscano-trachydolerite.* Under this usage *cimino*, *vulsino*, and *toscano*, take the same place with reference to the trachydolerites, that *hellefors*, *aasby*, *särna*, *ottfjälls* do to the diabases, as used by Rosenbusch (see p. ——). Indeed, Washington himself in one place speaks of *pulaskite* as *pulaskitic syenite*.[2] Following the plan proposed this would be *pulasko-syenite*. (3) As an illustration of the use of mineralogical terms compounded with names already compounded may be given *augite-toscano-trachydolerite*. If desirable, the order of the mineralogical and geographical parts of the name may be reversed. For instance, the leucite-trachytes, which Cross calls *orendite* and *madupite*,[3] may be designated *orendo-leucite-trachyte* and *madupo-leucite-trachyte*.

In all of these cases the geologist knows at once the general character of the rocks referred to. In the first case he knows the rocks are syenites; and, furthermore, that certain varieties of syenites are so abundant and so definite in character as to require a specific designation. In the second case he knows that there is a kind of rock intermediate between the trachytes and dolerites, and, if he knows what trachytes and dolerites are, he has a very clear conception of this rock without any further definition. He further knows that there are variations in the character of the trachydolerites which occur at particular localities, and which, in the opinion of the author, are so abundant and distinctive as to require specific designations. In the third case he further knows at once from the name that certain varieties of the Toscano-trachydolerite contain augite; and infers that this variety is exceptional. He knows that the leucite-trachytes have variations which are thought to be of sufficient importance to require specific designation.

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[1] JOUR. GEOL., Vol. V, pp. 350–361.

[2] JOUR. GEOL., Vol. VI. p. 804.

[3] Igneous rocks of the Leucite Hills and Pilot Butte, Wyo., by WHITMAN CROSS: Am. Jour. Sci., Vol. IV, 1897, pp. 138, 139.

It is also self-evident that the extreme refinement practiced by Washington and Cross is in no respect lost by using the nomenclature proposed, rather than assigning independent names to particular varieties of rocks described. Indeed, the compound names proposed give additional refinement to that attained by independent names.

In giving the above illustrations I express no opinion as to whether the various syenites, trachydolerites, and leucite-trachytes are so abundant and important as to be worthy of specific names. This is a matter for the petrographer to settle. I merely use these terms as convenient illustrations as to how rock nomenclature can be handled so as to serve the purposes of the general geologist and the specialist, without throwing the subject of petrography into hopeless confusion.

Objection to long names.—The long terms resulting from the plan, as, for instance, augite-toscano-trachydolerite, may be objected to on account of their cumbersomeness and complexity. However, it may be said that these names are simple as compared with many of the names used in organic chemistry, and furthermore that they are justified on precisely the ground that the long names in organic chemistry are justified, that is, they are intelligible names. This is the fundamental point. The present method of naming rocks is not intelligible even to professional petrographers, and an unintelligible method can no longer be tolerated. The method proposed is intelligible to every geologist, whether a specialist in petrography or not, and gives at once the information desired by the general geologist and the extreme refinement demanded by the petrographer. The plan proposed gives all the advantages of generic, specific, and varietal names. If any petrographer can suggest a method of naming rocks which will better satisfy the demand of the petrographer for exactness, and of the geologist for intelligibility, I shall gladly favor such a plan rather than my own proposal.

Why petrographers have not generally followed plan outlined.—The plan suggested is so simple that the question immediately arises as to why petrographers dealing with igneous rocks have not followed it. Was there not some good reason for the introduction during the past years of many new, independent names? The answer is, petrographers had not worked out any plan as to the naming of rocks, and to assign a new name for each new variety of rock was the easiest way out of the difficulty, although it was disastrous so far as their fellow workers were concerned. Then the honor of giving a new name to rock nomenclature doubtless had a too important effect. Furthermore, many of the petrographers still held, in a subconscious way, to the old notion of rock types, not yet having grasped the idea of general gradation.

Plan followed in case of sedimentary rocks.—That the scheme proposed is practicable is shown by the sedimentary rocks, where it has been substantially followed, although as a matter of necessity rather than a conscious system. In the sedimentary rocks, from the first, gradations were recognized, and hence the tendency to give each variety a new name never got any headway. To illustrate the application of the scheme to the sedimentary rocks, we may take the sandstones. There is an almost infinite variety of sandstones, but it so happens that petrographers have not been directing their energies to the minute discriminations of their variations, and we have not a dozen or score of different names for the different kinds of sandstone. Yet the sandstones of different localities are discriminated and recognized as different from one another by attaching the names of the localities at which the rocks occur to the name, and thus discriminating each rock from all others. For instance, in Wisconsin a peculiar sandstone occurring locally is called the Madison sandstone. From this designation the general geologist at once knows that this formation has the general characters of the rocks which have been called sandstone, and he will not go further. But if he is interested in the Madison district for some reason, scientific, economic, or otherwise, he may go further and learn the peculiarities of the particular sandstone which is found at Madison.

By this method the sedimentary formations are discriminated the world over. However numerous the names for the sedimentary rocks may be in the future, the method still must be used, for however fine the discriminations resulting from such names, there will be variations from the meanings assigned to these names, and thus the local names are necessary.

In exceptional cases plan followed with igneous rocks.—The simple method proposed of designating the slightly different varieties of igneous rocks from one another, without throwing their nomenclature into hopeless confusion, has already been followed in several cases.

A notable instance is the term *Andendiorite* proposed by Stelzner[1] for a particular rock which has the general characters of a diorite, but which in some respects differs from ordinary diorite, and occurs in the Andes. A geologist who does not care to go into the detailed petrography of the region notes at once that in the Andes is a rock which has the general characters of the diorites, but which in some respects differs from the ordinary kind. He also at once knows that in the Andes is a rock which is different from the ordinary diorites, but which is allied to them. If in his investigative work he wishes to know exactly the meaning of the modifying term, he can do so by reading Stelzner's paper, or by obtaining specimens and an analysis of the rock. In the case of *Andendiorite*, the name has been also used as a new specific name, an dapplied by Iwasaki[2] to a somewhat similar rock in Japan. To a certain degree this shows how the method may be made to work out in practice in reference to the igneous rocks. When here and there other rocks are discovered similar or almost identical with the Andendiorite, and this variety of rock, as a result of these investigations, is found to be so abundant and so definite in its characters as to demand a specific name, the original word *Andendiorite* may be used for this purpose, or, better, a new specific name may be coined for it, and the rock be placed in the scheme of rock nomenclature.

Rosenbusch has used the method of geographical qualifiers in a number o finstances precisely as proposed, for discriminating rocks. For example, he describes *helleforsdiabas*, *aasbydiabas*, *sarnadiabas*, *ottfjallsdiabas*.[1] Had some petrographers described these rocks perhaps we would have had four additional, independent names to remember, the value of which we would know absolutely nothing of, without any suggestion whatever as to the family, in Rosenbusch's sense, to which these new rocks belong.

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[1] A. STELZNER: Geologie und Paläontologie, von Argentina, p. 213.

[2] Andendiorite in Japan, by C. IWASAKI: JOUR. GEOL., Vol. V, 1897, pp. 821–824.

The method proposed has unconsciously been followed to some extent by the United States Geological Survey. That organization has recognized that a sufficient number of independent names could not and should not be coined to designate every variety of rock. It has practically, if not by definition, recognized the endless variation and gradation throughout rock formations, by providing that *aqueous and metamorphic formations alike* should be given local names; for example, Chicopee-shale, Hoosac-schist, Becket-gneiss, etc.[2] This use of local names has furnished a more accurate method of discrimination than could be afforded by independent names. Moreover, only rocks which are present in some quantity have been given formation names. Thus, by practice at least, the idea of abundance as a factor in the naming of rocks has been recognized.

Suggestion to petrographers who have introduced new names.—In this connection it may be suggested that petrographers who have recently introduced new independent names would perform a service to geologists who are not petrographers, and to many other petrographers, by giving in subsequent papers equivalent names on the basis of the plan above advocated, to the special rocks to which they have given names. If this be done, the relative merits of the two plans will be tested. Within a short time it will be seen whether geologists and petrographers use the independent names or the more general names compounded with geographical and mineralogical terms. Where a new independent name was really needed, and performs a service in the advancement of science, it will be sure to be retained. If it drops out of use, its proposal was premature.

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[1] Mikroskopische physiographie, II, Massige Gesteine, H. ROSENBUSCH; S. 219–220.

[2] Holyoke folio No. 50, Geological Atlas of the United States.

Summary of advantages of proposal.—In conclusion, some of the advantages of the foregoing plan may be summarized:

1. The plan proposed serves all the purposes of nomenclature, from names of a general character to those giving the most minute discriminations. It has the advantage of grouping different varieties of rocks under terms, the general meaning of which is known to all. In the matter of nice discrimination it far surpasses the plan of independent new names for new varieties of rocks. It permits at once any difference in the character of a rock, however slight, to be discriminated, and it permits the growth of petrography by the grouping of the allied varieties together under a new specific name so soon as they shall have been found so abundant, so peculiar, or so important as to demand such a name. The professional petrographer will thus have a much more convenient and elastic nomenclature for describing rocks than he has at present. He may ignore minor differences between rocks in one sentence, and in the next sentence deal with the most refined differences between them. Thus the plan advocated meets both the demands of the geologist and of the specialist in petrography.

2. The plan proposed puts the available information of petrography in such shape that some master mind in the future may reduce the subject to a science. The present scheme of rock nomenclature makes it impossible for any person to get the facts clearly before his mind in such a way that they can be handled. The provisional scheme proposed accomplishes this end. If it be generally followed by petrographers, it is probable that within a few years it will be possible to propose a definite scheme of rock nomenclature, the terms of which correspond roughly to genus, species, and variety in biology.

3. It is believed, if once rock nomenclature be placed upon a reasonable basis, that this will be a great step toward the establishment of a satisfactory scheme of rock classification.

4. Under the plan suggested it will be easy for the student

to get definite notions of the common kinds of rocks. Having this knowledge, he knows without explanation the meaning which is to be attached to a name compounded of two of them. He knows without a moment's reflection the meaning of a mineralogical qualifier prefixed to a noun. He knows that a geographical qualifier means the particular variety of rock which occurs in a certain district. Thus it will be possible for a student to gain a comprehensive knowledge of the chief kinds of rocks at a very early stage of work, and to supplement his general knowledge by details as his work advances.

5. A further advantage of the foregoing plan will be that many of the earliest rock names proposed will be retained, although some may be abandoned. The reason why so many of the old names will be retained under the plan proposed is that many of the abundant rocks were first found; for, as already noted, while the petrographers supposed they were following the plan of naming rocks on the basis of types, they were largely following the plan of naming rocks on the basis of abundance.

6. Still another of the manifest advantages of the plan is that it throws the emphasis on the proper thing; it calls attention to the common, not to the exceptional, rocks. Many petrographers, in discussing the rocks of an area, describe with the utmost particularity the minute characteristics which are peculiar to the exceptional rocks of the district or region, and say comparatively little of the common rocks which compose the great mass of the rocks of the area. Of course, there is some justification for this, in that the characters of the common forms are known. But all papers describing the geology of a region should be so framed as to give a clear conception of the common kinds of rocks which are preponderant, and indicate that the exceptional things described in such detail are only so described because of their peculiarities. To the reader in some way should be conveyed the idea of the relative abundance of the rocks. The error of emphasizing the exceptional and overlooking the common phenomena has been one of the most pernicious mistakes which runs throughout geological papers and text-books. For instance,

many pages in a text-book are given to a discussion of earthquakes, and only a small fraction of that space is given to the vastly more significant, slow earth movements which occur without earthquakes or with earthquakes as secondary phenomena.

7. Finally, the foregoing plan has one further advantage. It emphasizes a great law of nature, the law of gradation—the principle that ultimately there is no such thing as an absolute type. In this respect, petrography, if it will but use its opportunity, has an advantage over any other subject. In biology there have once been gradations between species, between families, between classes. Many of these gradations have been destroyed in the course of evolutionary processes. However, in petrography all of the gradations yet persist, and thus it furnishes the best illustration of the principle of gradation, a fundamental principle of nature.

C. R. VAN HISE.

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